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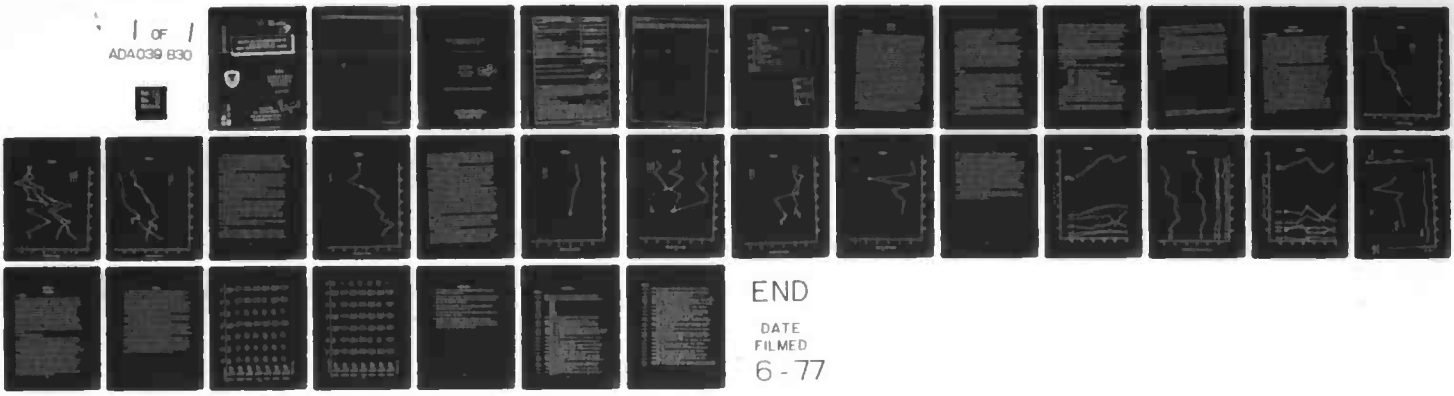

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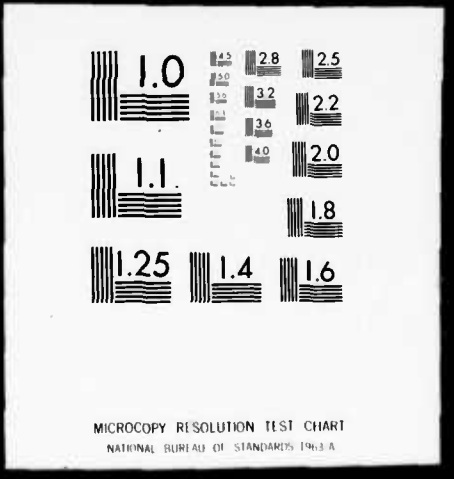

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IMPACT OF IMPLEMENTATION OF DoDi 4140.39 AT ARMY INVENTORY CONTROL POINTS

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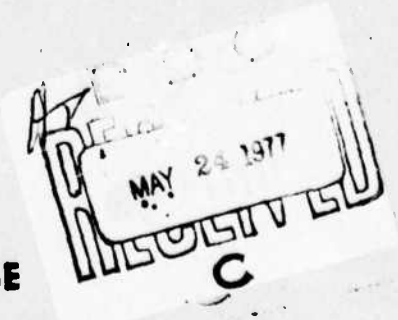

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IMPACT OF IMPLEMENTATION OF DoDI 4140.39 AT ARMY INVENTORY CONTROL POINTS

FINAL REPORT

BY

ROBERT L. DEEMER

APRIL 1977

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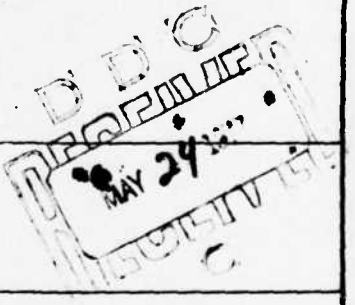

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Commodity Command Standard System

403572 XX

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

In June 1974 the Army Wholesale Supply System started implementing the management concepts of DoDI 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items." The techniques embodied in the DoDI are quite different from those that were followed previously and there was much interest in how cost effective the new ideas were. This report presents some performance and cost statistics which indicate the new techniques are indeed cost effective. Precise figures are difficult to present because of the interaction →

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of functions outside the scope of DoDI 4140.39 but available data indicate that significant improvement in supply performance did take place over the period, September 1973 to December 1976.

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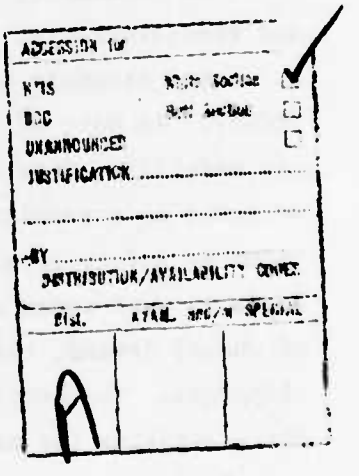


CHAPTER I

DoD MODEL

1.1 Background

In August 1968, an advisory group from the Military Services and DSA (Defense Supply Agency, now called Defense Logistics Agency) was convened for the purpose of revising DoD Instruction 4140.11, "Peacetime Operating and Safety Levels of Supply," June 24, 1958. The results of the group's work was a new Instruction, DoD Instruction 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items," July 1970 [4]. The supply management concepts and techniques embodied in the new DoDI are quite different from those that were followed within the US Army Materiel Development and Readiness Command (DARCOM) under the old Instruction. These new techniques were believed to be superior to the old in terms of requisition fill per dollar of inventory investment and it was postulated that improvement in supply performance ought to be discernable at the Inventory Control Points (ICPs) after they had been in use for a long enough period of time for the new requirements levels to take affect.

The implementation of the DoD model was only a part of the automation and standardization of many aspects of supply management at the ICPs. The automated standard system is called the Commodity Command Standard System (CCSS). As part of CCSS a pre-implementation evaluation of expected results was made [5]. This evaluation indicated better cost/performance could be achieved as a result of improvements in several areas beside the computations of safety levels and order quantities. These areas include improvements in such areas as the requirements determination time, the forecast of annual demand, the administrative lead time and procurement delivery slippages. The development of these areas should be kept in mind when the statistics for performance and cost are presented in Chapter 2.

Performance statistics were gathered from the Military Supply and Transportation Evaluation Program (MILSTEP) from as far back as records were kept (September 1973) to the end of 1976 (December).

In order to normalize the comparison - that is, to compare supply performance before and after implementation of 4140.39 at equivalent demand rates, inventory investment, etc., - data was obtained from the Army Budget Stratification System. While this data was not available for so far back as the performance data, there was enough available to allow these normalized comparisons to be made.

This report will describe the DoD model in very general terms, in particular pointing up how it differs from the previously used model. This is the model that was implemented in CCSS, the computerized standard system used at the ICPs to compute the management parameters necessary to fulfill DoDI 4140.39. The DoD model is implemented in the Army under guidance of AR 710-1, Chapter 4, where the specific procedures to be used by the Army are prescribed. The report will show the performance and cost figures and discuss the consequences of implementing the DoD model.

1.2 Model

DoDI 4140.39 [4] is directed to the Inventory Control Points at the wholesale level of supply. It is at this level that budget allocations for procurement funds are made and wholesale buys are accomplished. The DoDI directs the computation of management parameters, the variable safety level and economic order quantity (VSL/EOQ).

The objective of the DoD model is to minimize the total variable order and holding cost subject to a constraint on the time-weighted, essentiality-weighted requisitions short [2]. This formulation calls for the use of a shortage parameter. This is an implied shortage cost since the real shortage cost is unknown. This implied cost can be used to determine the management parameters, either from a target estimate of delay in filling requisitions, or from a constraint on funds available for procurement.

The DoD model target availability depends on each item's contribution to backorder avoidance per dollar invested. This allows each item to have

a unique availability target. The previous model minimized total variable order and holding cost subject to a constraint on time-weighted dollars short. This formulation only allowed for grouped item target availabilities (the Army was using two group targets - one for high and medium dollar value items and one for low dollar value items). It was because of this individuality of item target availabilities that the improvement in cost/effectiveness was expected.

Quantitatively there are other differences in the models; however, these differences are really secondary as compared with the above mentioned distinctions. For example, the new CCSS computations use a combination Laplace and negative binomial probability distribution to describe demand whereas before the computations were based on the normal probability distribution of demand.

1.3 Implementation

Presently there are six ICPs in the DARCOM wholesale supply system. They are:

- TROSCOM - Troop Support Command
- ARRCOM - Armament Materiel Readiness Command
- ECOM - Electronics Command
- AVSCOM - Aviation Systems Command
- TARCOM - Tank-Automotive Materiel Readiness Command
- MIRCOM - Missile Materiel Readiness Command

Many of the management functions of the ICPs are standardized and automated under the Commodity Command Standard System, CCSS, of which the VSL/EOQ computation is a part. CCSS was not implemented at the same time at all the ICPs. It was implemented at AVSCOM and MIRCOM in June 1974. Thereafter, it was implemented at various times at the other Commands until January 1977 when TARCOM was the last to implement the total CCSS package.

Two of the Commands (TARCOM and ARRCOM) implemented the VSL/EOQ computations in stages. TARCOM implemented the Budget Stratification

(STRAT) [1] program in September 1974. This used the basic DoD model to compute the VSL/EOQ values but they were only updated when the STRAT was run, i.e., quarterly. Then in January 1977, the total CCSS package was implemented.

ARRCOM implemented the VSL/EOQ computation via sets of tables which translated the "across-the-board" item availabilities into better approximations to individual item availability. These new tables were based on the previous model mathematical derivations; however, more target availabilities were chosen so there could be more individuality given to items than had previously been done. ARRCOM started using the multi-target availability tables in June 1974 and implemented the full CCSS package in March 1976.

ECOM had been using a method of computing the VSL/EOQ values which was completely different from the method of the other ICPs.* They did not use any intermediate form of the DoD model and they implemented CCSS in January 1976.

*Harbridge House, Inc., "Field Test of Economic Inventory Policy - Report #3: National System Final Report," December 1960, Boston, Massachusetts.

CHAPTER II

MODEL EFFECTIVENESS

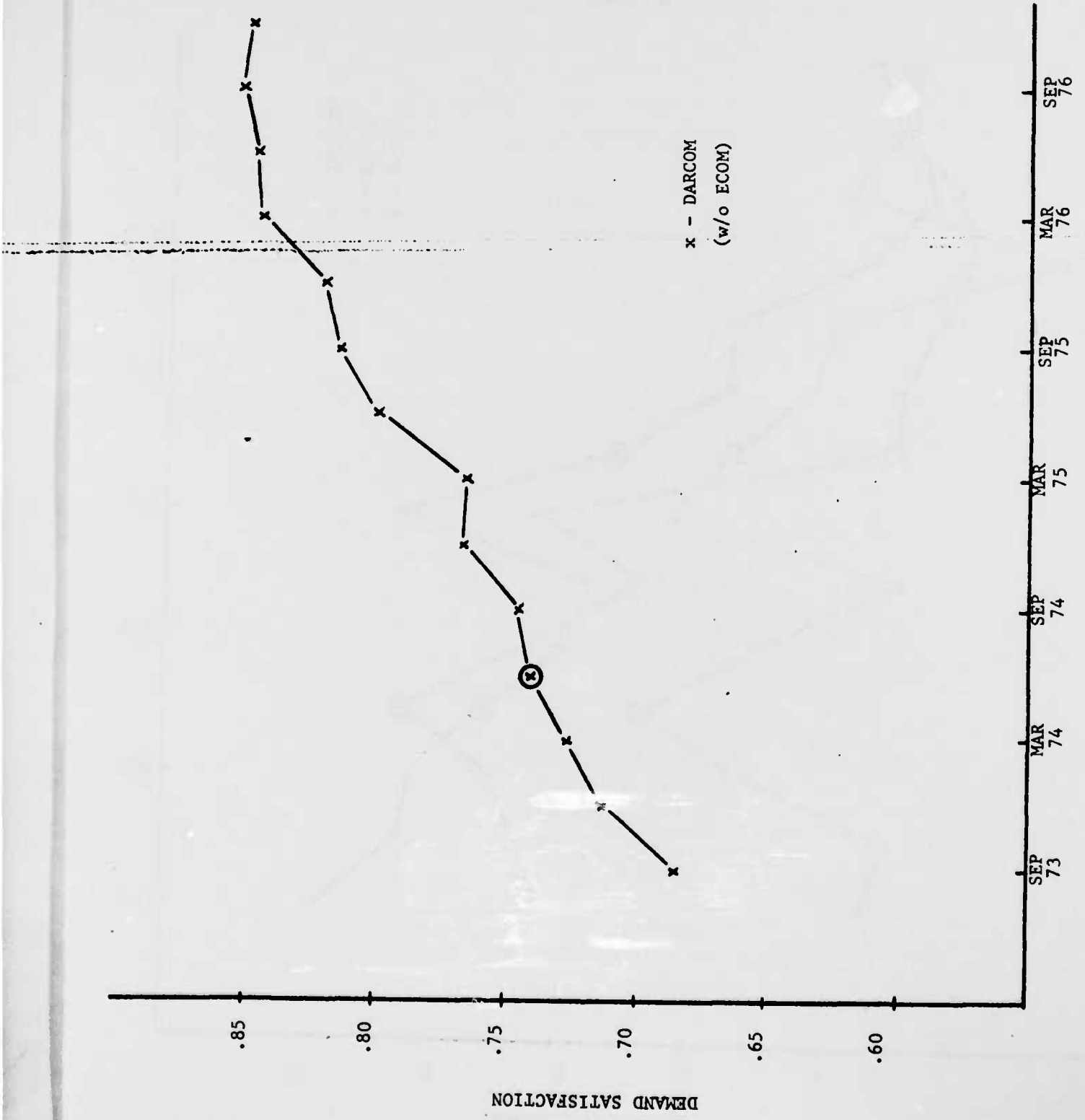
2.1 Performance

The performance examined for this work was demand satisfaction, i.e., the ability of the ICP to fill a requisition from stock on-hand. This measure only considers stocked items because the model being evaluated is for use only with stocked items. The performance figures were obtained from the Military Supply and Transportation Evaluation Procedure (MILSTEP) [3] reports prepared by the Logistics Systems Supply Agency (LSSA). Demand satisfaction is computed by dividing the number of requisitions which were filled immediately by the net number of requisitions for all items (total number of requisitions minus passing and reject actions). See the Appendix for actual values of backorders, net demand, etc.

Figure 1 shows the satisfaction for the US Army Materiel Development and Readiness Command (DARCOM) excluding ECOM. This exclusion will be explained later. The point with the circle around it is the first quarterly entry for which the VSL/EOQ model was implemented at any ICP. AVSCOM and MIRCOM were the first ICPs to implement the VSL/EOQ module. That was in June 1974. The next ICP to implement was TROSCOM in July 1974. The performance of these three ICPs is shown individually in Figure 2. The circled points represent implementation time. The broken line segment represents the transition time when the effects of the new procedure were taking hold. The broken line circle represents the end of the transition period. This transition period was chosen as 12 months, corresponding to a representative value for procurement lead time.

Figure 3 shows the performance figures for ARRCOM and TARCOM. Both of these ICPs implemented the VSL/EOQ model at later dates than the three ICPs mentioned above and these two also implemented in stages. The full circled points in this Figure indicate the implementation of the complete CCSS package.

FIGURE 1


DEMAND SATISFACTION
.85
.80
.75
.70
.65
.60
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76
x - DARCOM
(w/o ECOM)

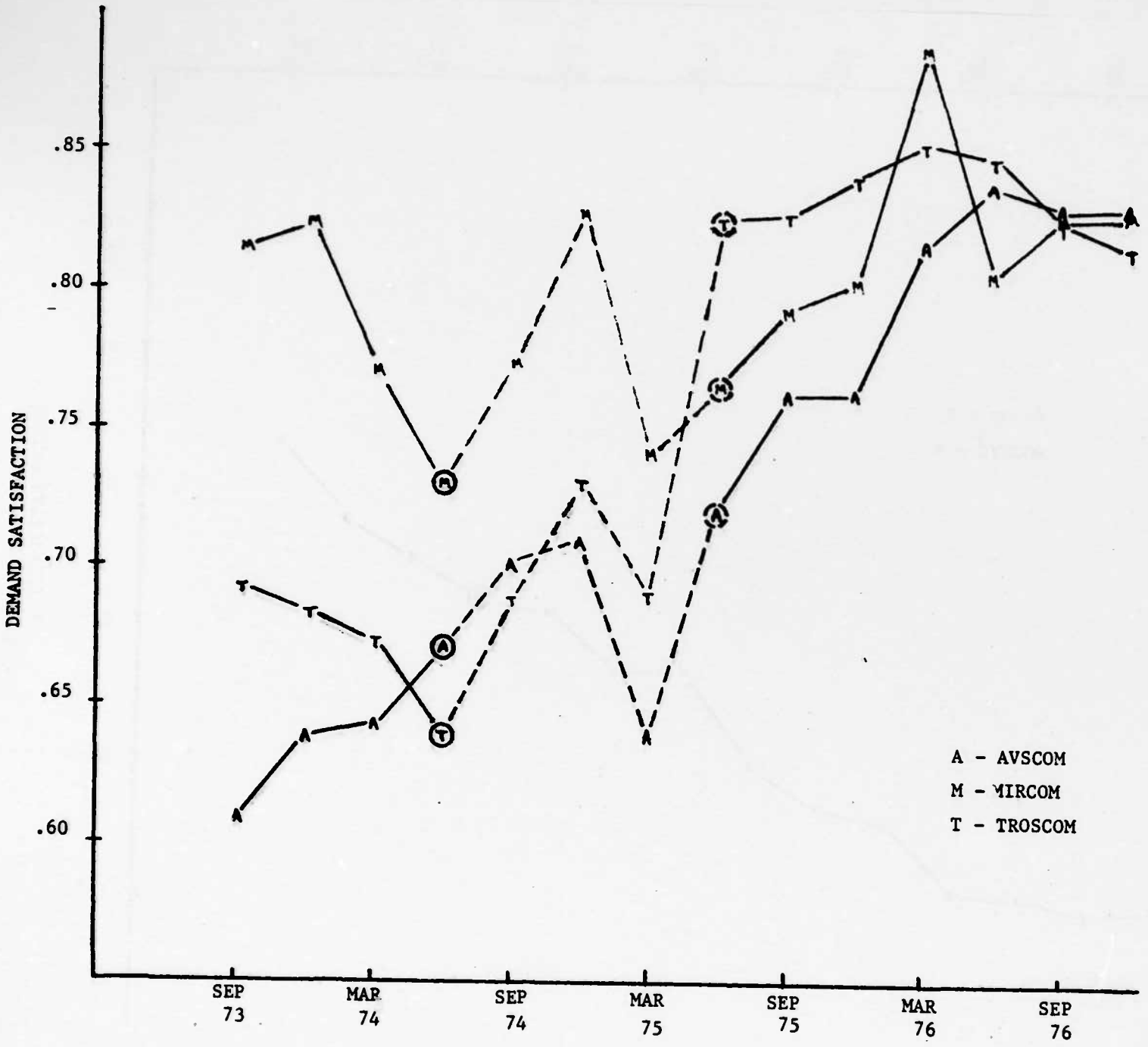

DEMAND SATISFACTION
.85
.80
.75
.70
.65
.60
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76
A - AVSCOM
M - MIRCOM
T - TROSCOM

FIGURE 2

FIGURE 3

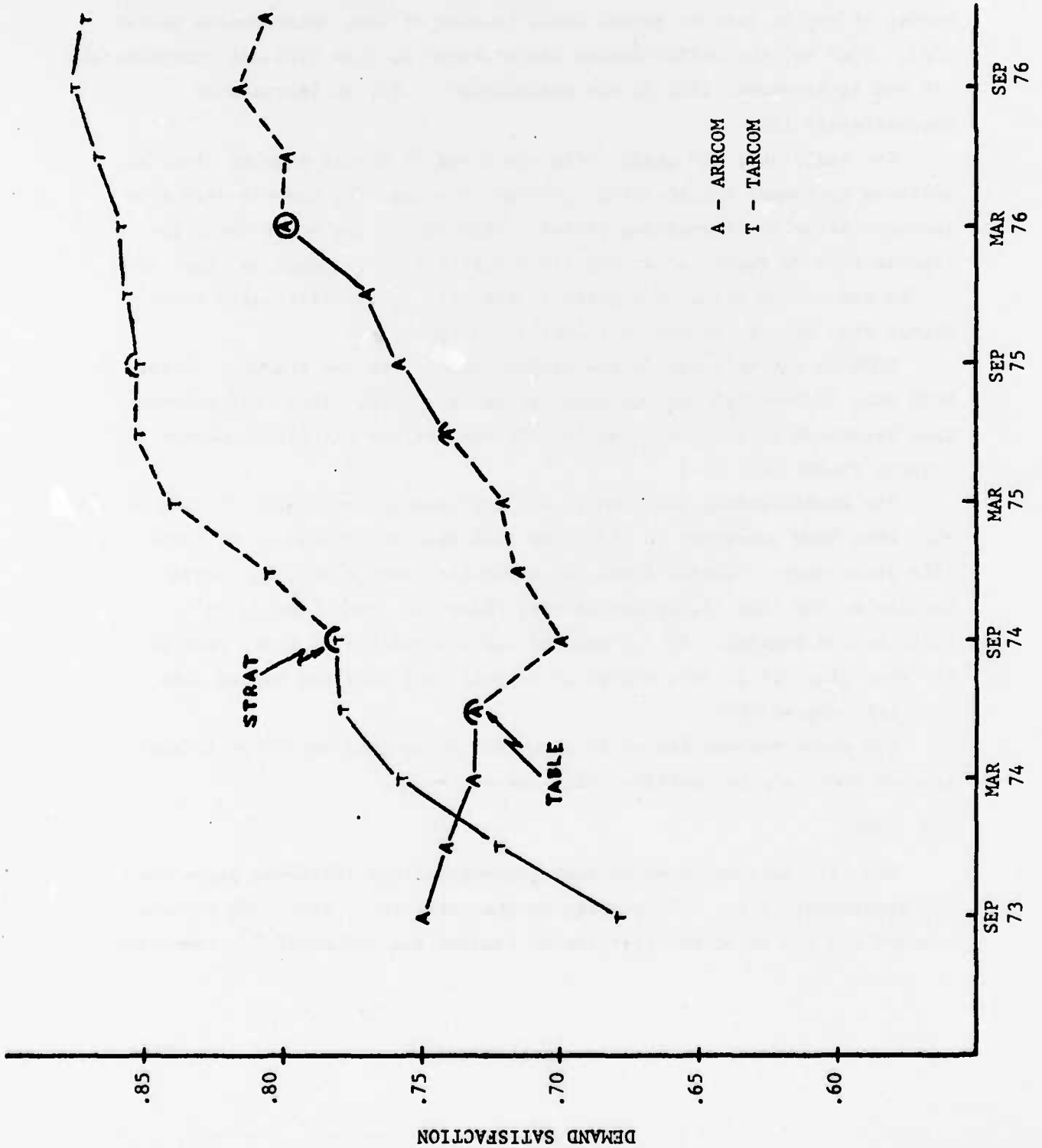

DEMAND SATISFACTION
.85
.80
.75
.70
.65
.60
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76
A - ARRCOM
T - TARCOM
STRAT
TABLE

Figure 1 shows that the performance over all the ICPs has increased at an almost steady rate since the first ICP implemented CCSS in June 1974. Of course, it was increasing the three quarters before that also; hence, it may be just an upward trend because of some other reason beside CCSS. Even so, the DARCOM demand satisfaction in June 1974 was approximately .74 and in September 1976 it was approximately .85, an increase of approximately 15%.

The individual ICP graphs (Figures 2 and 3) do not show as clear an increase in demand satisfaction. AVSCOM, for example, shows a very nice increase after the transition period. TROSCOM, on the other hand, increases then decreases after the transition period and ends up lower than at the end of the transition period. However, it is still quite a bit higher than before TROSCOM implemented the DoD model.

ECOM is not included in the DARCOM results for two reasons. First, ECOM only implemented the DoD model in January 1976. Thus, any information presented in the graphs would only reflect the transition period and nothing beyond this time.

The second reason why ECOM is not included in the DARCOM figures is that when ECOM converted to CCSS they also made major changes in their file structures. Because there was a complete change over in record keeping at the time of implementation, there was discontinuity in their record keeping. As a result of the instability of their records for this time, it is very difficult to tell just what did happen when they implemented CCSS.

The above reasons led us to show ECOM in an isolated graph (Figure 4) and not state any observations with respect to it.

2.2 Cost

The last section revealed that performance had increased since the implementation of the CCSS package at the first ICP. There may be many reasons for the increased performance besides the DoD model for computing

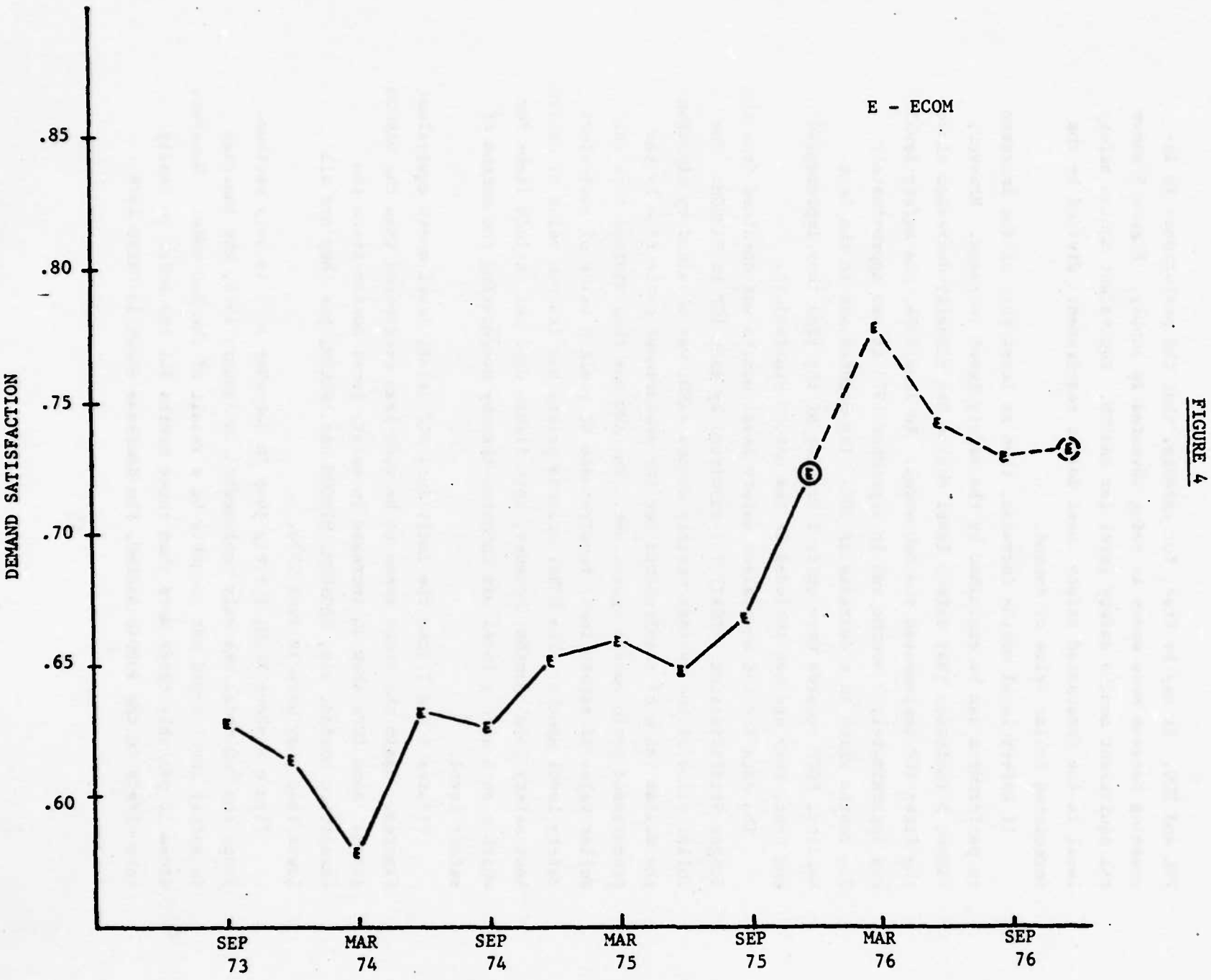

E - ECOM
DEMAND SATISFACTION
11
.85
.80
.75
.70
.65
.60
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 4

VSL and EOQ. It may be true, for example, that the performance is increasing because more money is being invested in supply. Figure 5 shows the equivalent months safety level for DARCOM. Equivalent months safety level is the forecasted safety level dollar requirements divided by the forecasted dollar value of demand.

If safety level months increase, then at least part of the increase in performance can be explained by the safety level increase. However, Figure 5 indicates that safety level months has actually decreased since the first ICP implemented the DoD model. In June 1974, the safety level was approximately 3 months and in September 1976 it was approximately 2.4 months which is a decrease of 20%. (As pointed out in the last section, ECOM records were quite irregular at the time they implemented and hence they are not included in the DARCOM statistics).

The data for the equivalent safety level months was obtained from the Budget Stratification (STRAT) [1] submitted by each ICP to DARCOM. The dollar value of the average monthly demand (AMD) was obtained by dividing the dollar value of requirements for the procurement cycle time by the procurement cycle months equivalent. The AMD was then divided into the dollar value of safety level requirements to yield a value of equivalent safety level months. The STRAT process prints out its own value of equivalent safety level months; however, this figure does not include items for which a zero safety level was computed thereby overstating the months of safety level.

Figures 6 and 7 show the individual ICP safety level month equivalent figures. Again the trend seems to be much less pronounced than the DARCOM graph. Some ICPs show an increase in safety level months since the transition period, viz, TROSCOM, MIRCOM and ARRCOM, but they are all lower than they were in June 1974.

Figure 8 shows ECOM; the big jump in December 1975 is very obvious. Since the DoD model was only implemented in January 1976, the increase in safety level could not possibly be a result of the DoD model. However, since it probably takes more than three months for the model to really take effect in the supply system, the decrease shown in March 1976

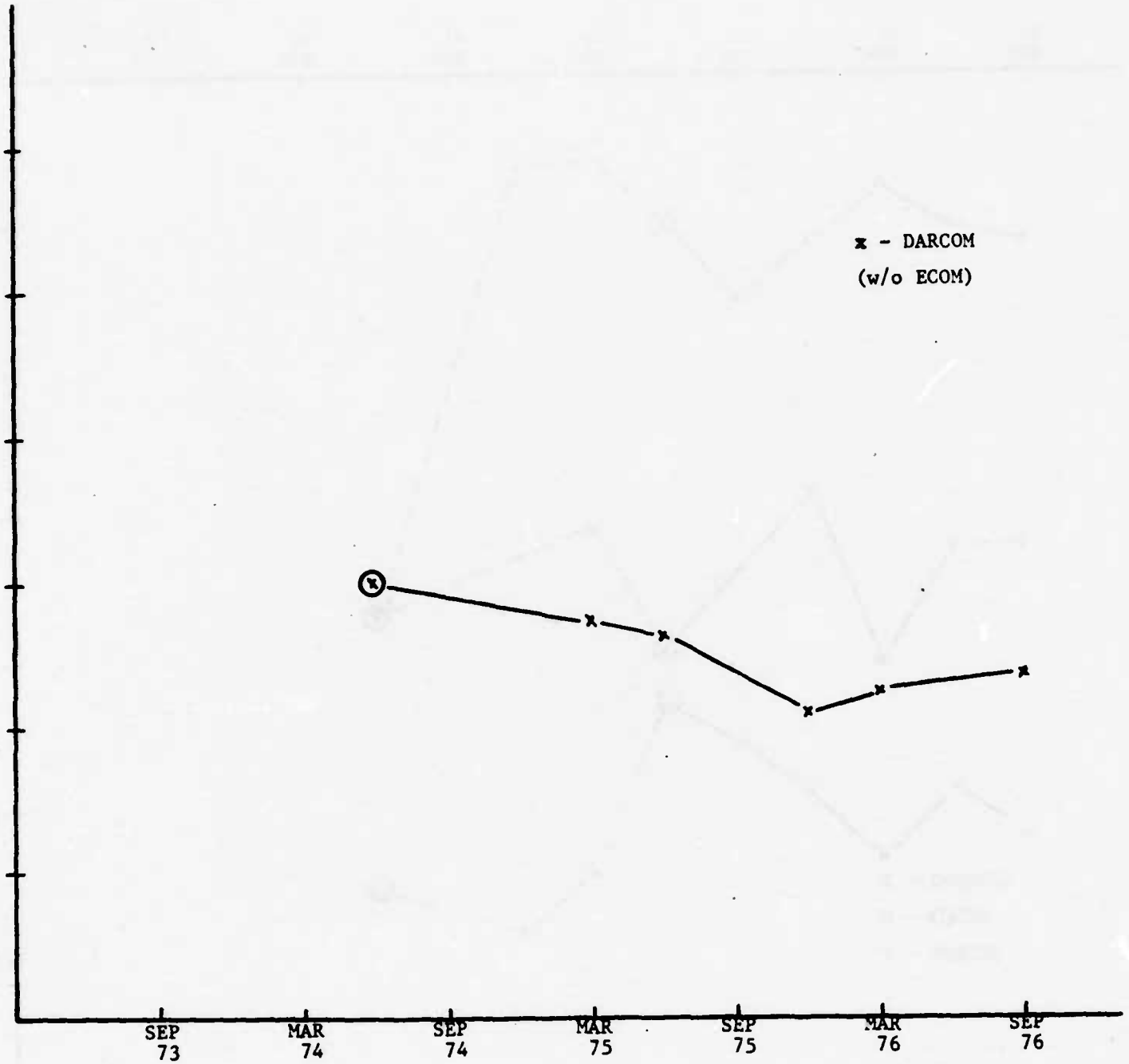

SAFETY LEVEL (MONTHS)
6.0
5.0
4.0
3.0
2.0
1.0
x - DARCOM
(w/o ECOM)
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 5

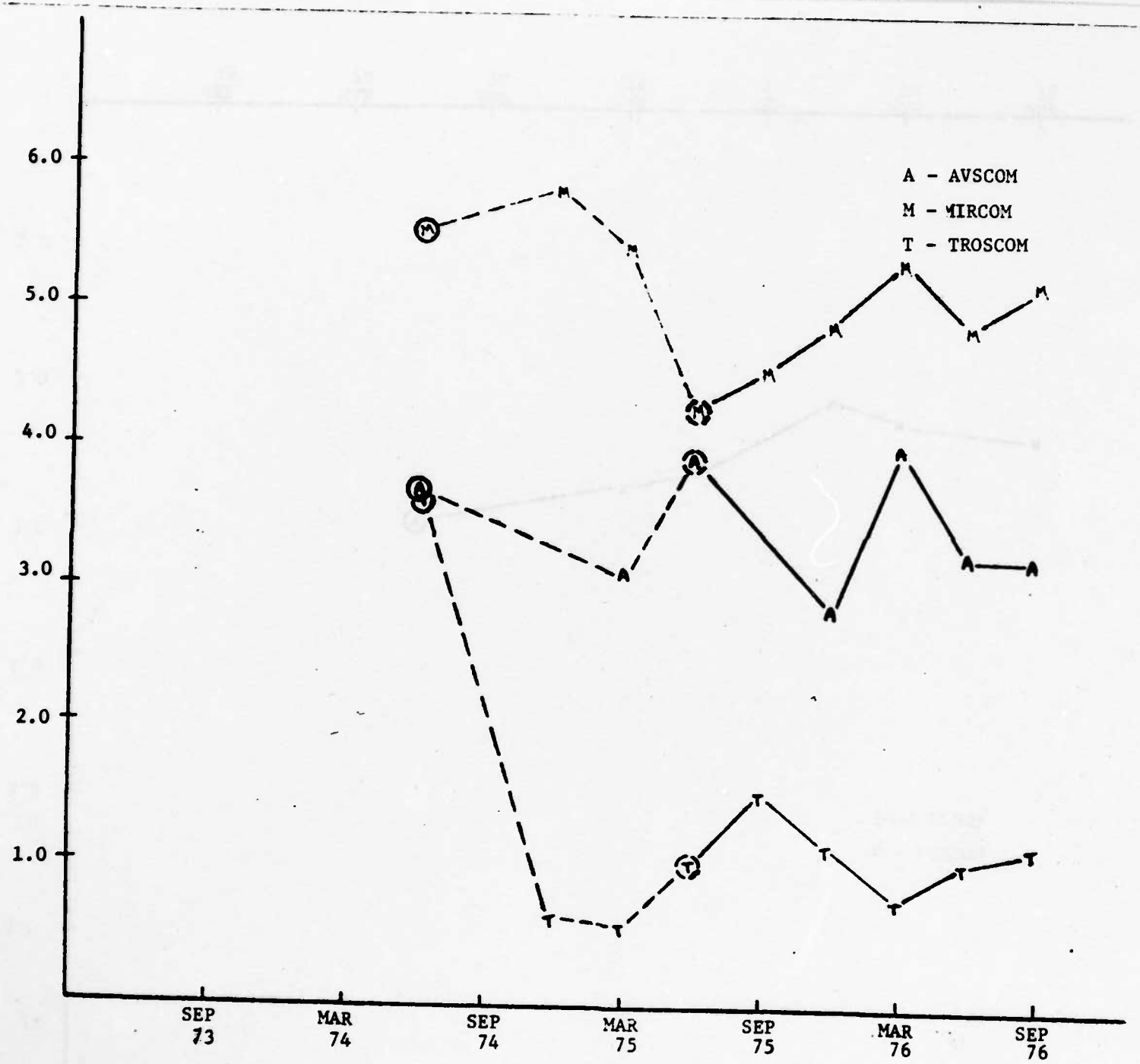

A - AVSCOM
M - MIRCOM
T - TROSCOM
SAFETY LEVEL (MONTHS)
6.0
5.0
4.0
3.0
2.0
1.0
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 6

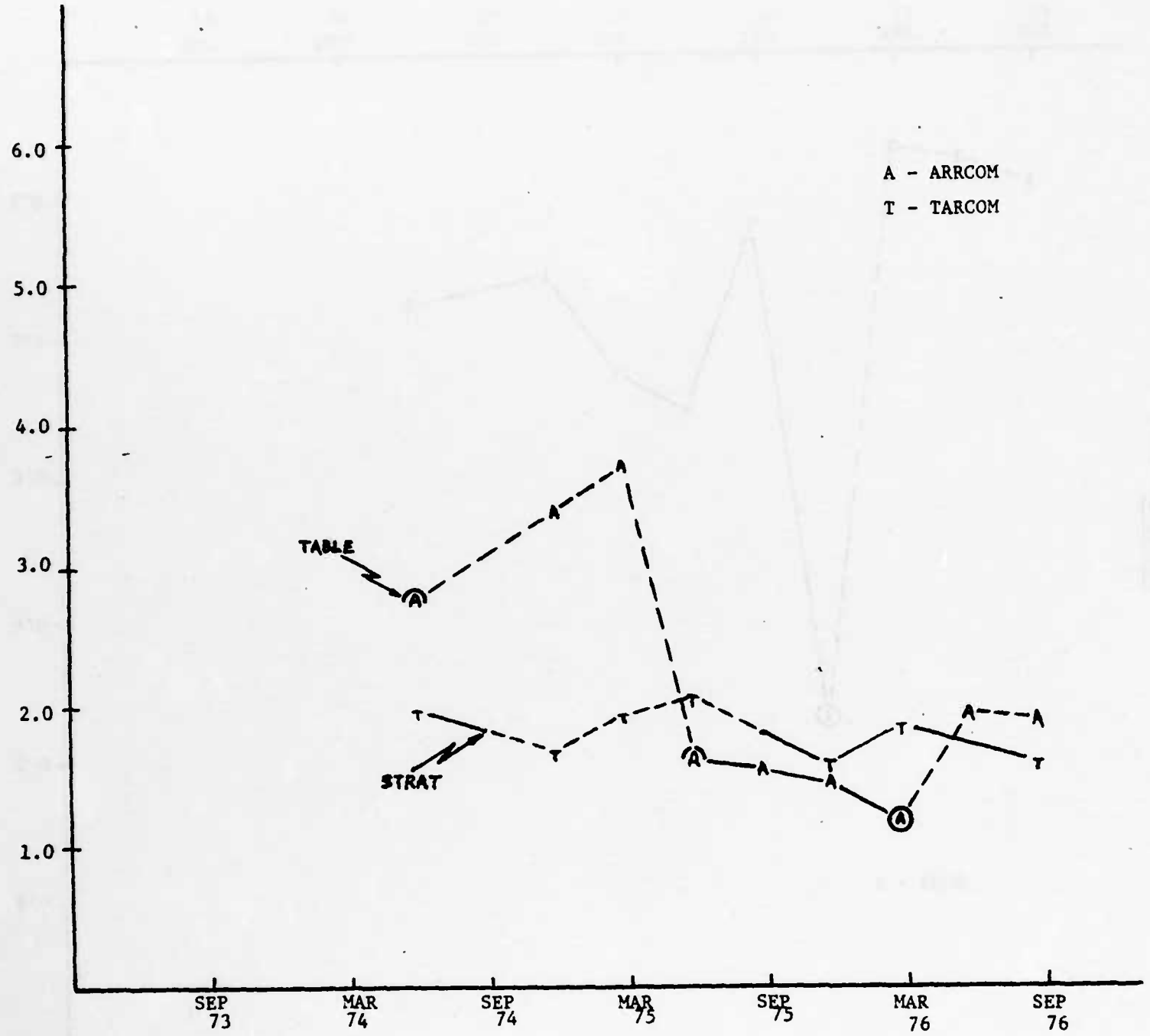

A - ARRCOM
T - TARCOM
SAFETY LEVEL (MONTHS)
6.0
5.0
4.0
3.0
2.0
1.0
TABLE
STRAT
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 7

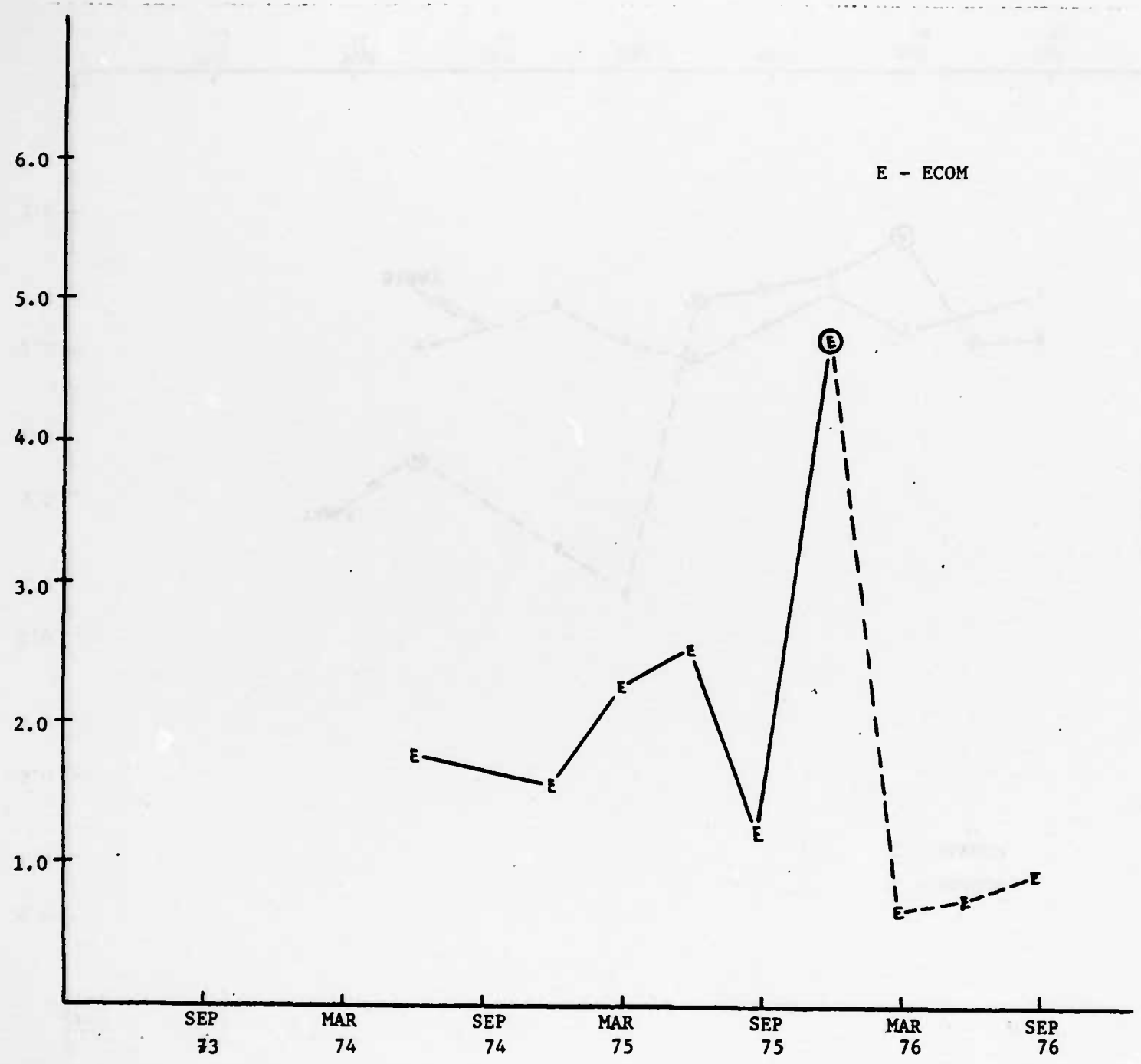

E - ECOM
SAFETY LEVEL (MONTHS)
6.0
5.0
4.0
3.0
2.0
1.0
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 8

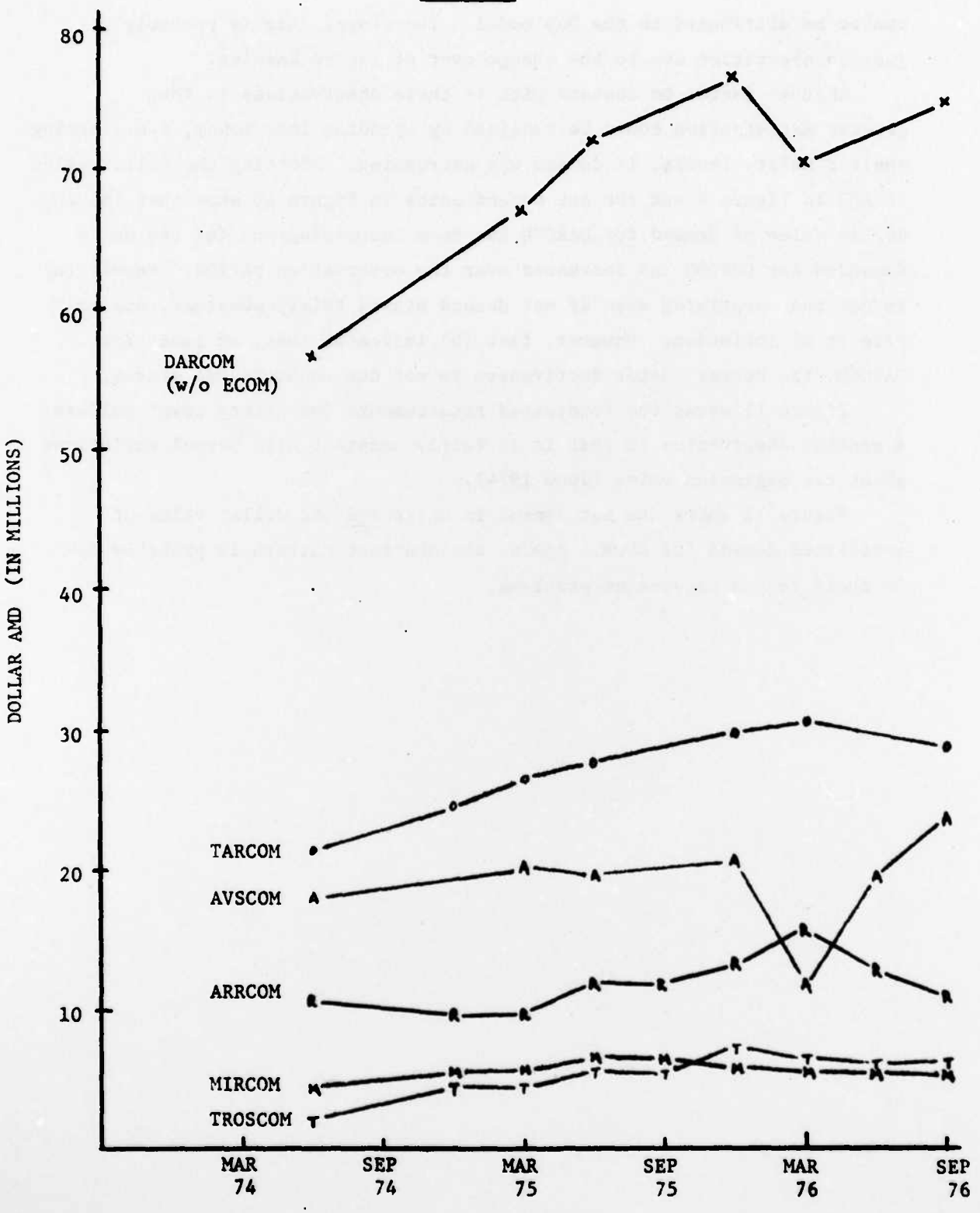
cannot be attributed to the DoD model. Therefore, this is probably just an aberration due to the change over of record keeping.

Another factor to contend with in these observations is that greater satisfaction could be realized by spending less money, i.e., having smaller safety levels, if demand was decreasing. Plotting the dollar value of AMD in Figure 9 and the net demand units in Figure 10 show that (a) the dollar value of demand for DARCOM has been increasing and (b) the units demanded for DARCOM has increased over the observation period. Result (a) is not too surprising even if net demand stayed fairly constant, due to effects of inflation. However, fact (b) indicates that, at least for DARCOM, the better cost/effectiveness is not due to decreased demand.

Figure 11 shows the forecasted requirements for safety level dollars. A general observation is that it is fairly constant with normal variations about the beginning value (June 1974).

Figure 12 shows the net demand in units and the dollar value of forecasted demand for ECOM. Again, the aberrant pattern is probably due to their record conversion problems.

FIGURE 9


80
70
60
50
40
30
20
10
DOLLAR AMD (IN MILLIONS)
DARCOM
(w/o ECOM)
TARCOM
AVSCOM
ARRCOM
MIRCOM
TROSCOM
MAR
74
SEP
74
MAR
75
SEP
75
MAR
76
SEP
76

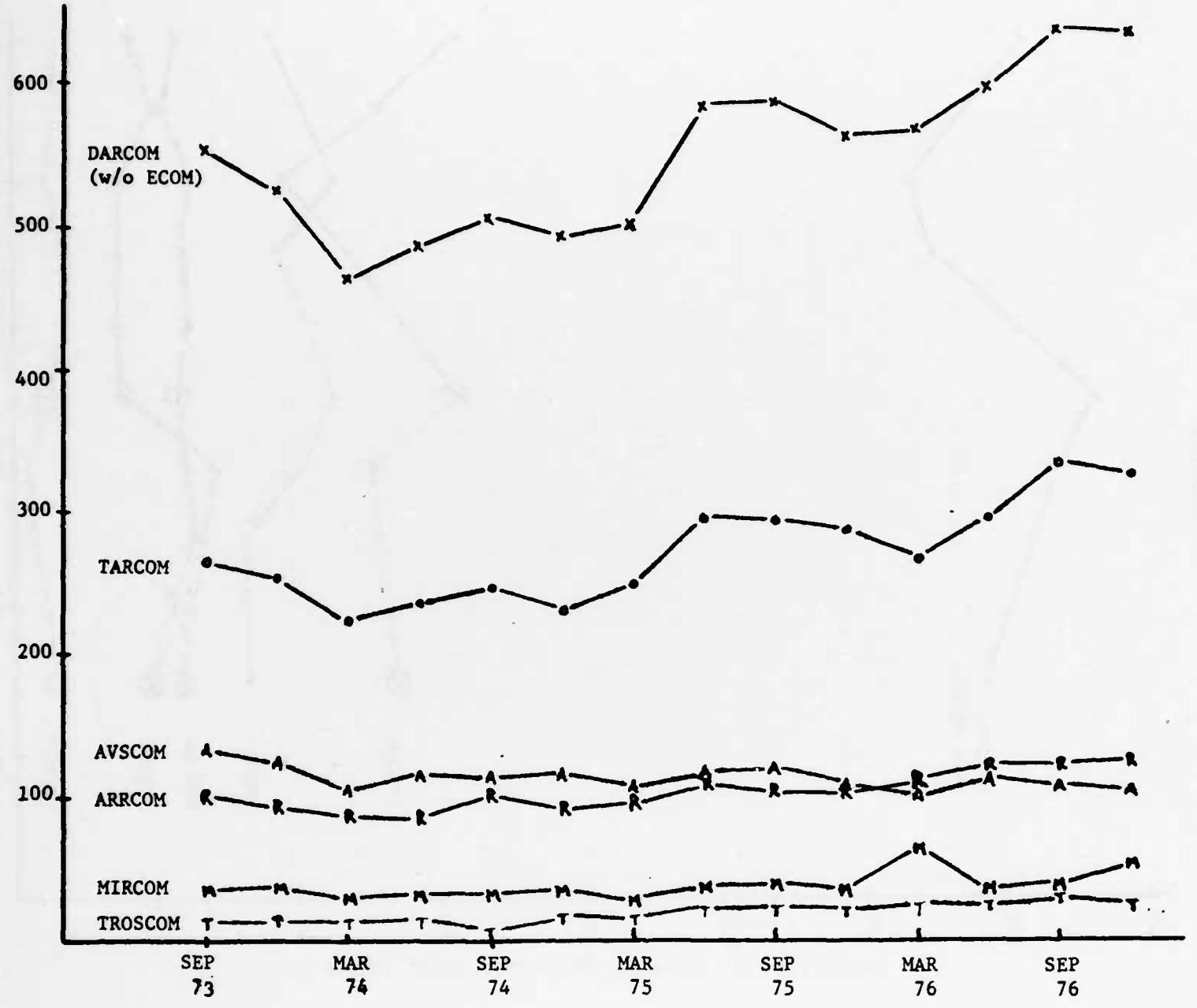
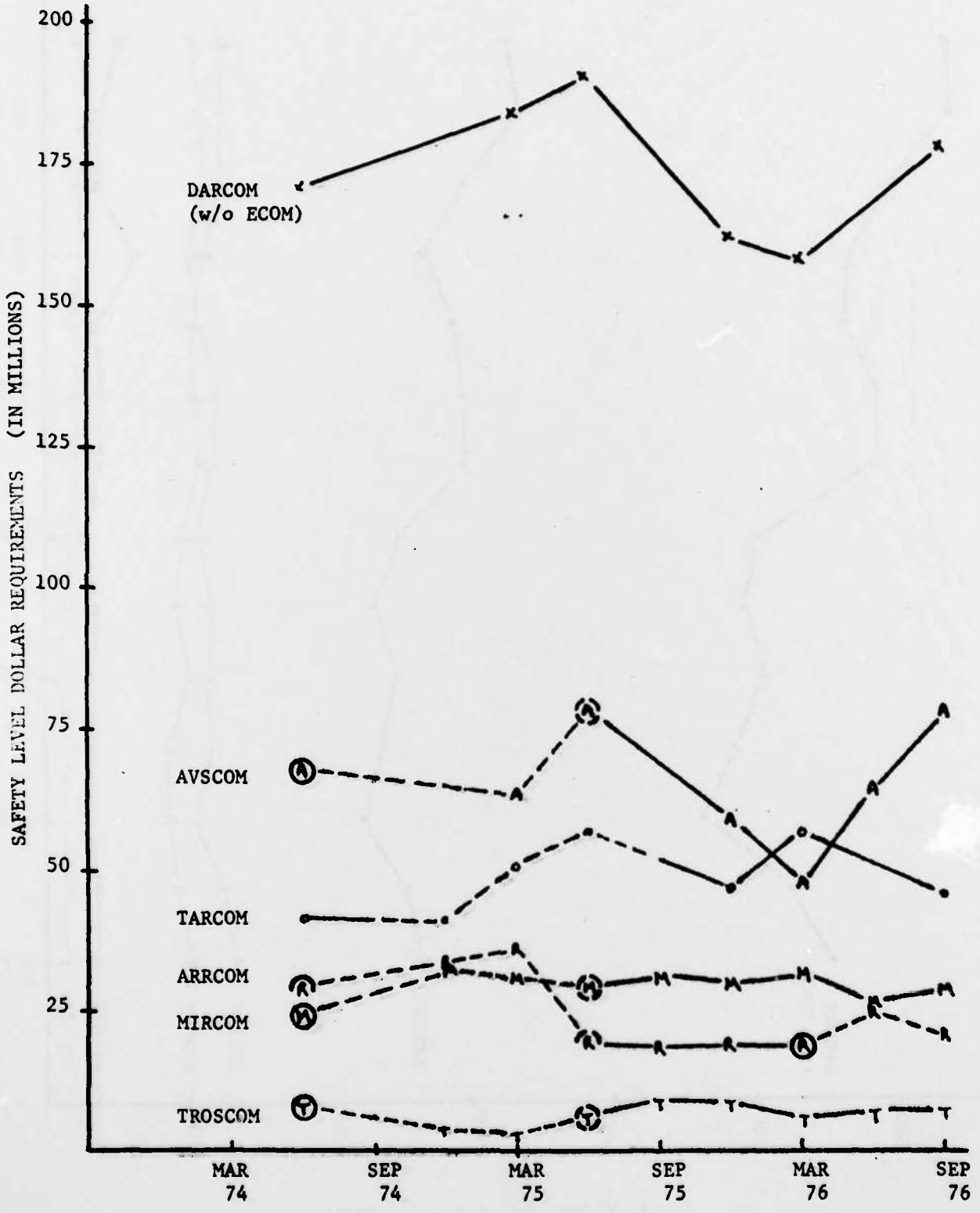

NET DEMAND (UNITS) (IN THOUSANDS)
600
500
400
300
200
100
DARCOM
(w/o ECOM)
TARCOM
AVSCOM
ARRCOM
MIRCOM
TROSCOM
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 10

FIGURE 11


200
175
150
125
100
75
50
25
SAFETY LEVEL DOLLAR REQUIREMENTS (IN MILLIONS)
DARCOM
(w/o ECOM)
AVSCOM
TARCOM
ARRCOM
MIRCOM
TROSCOM
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

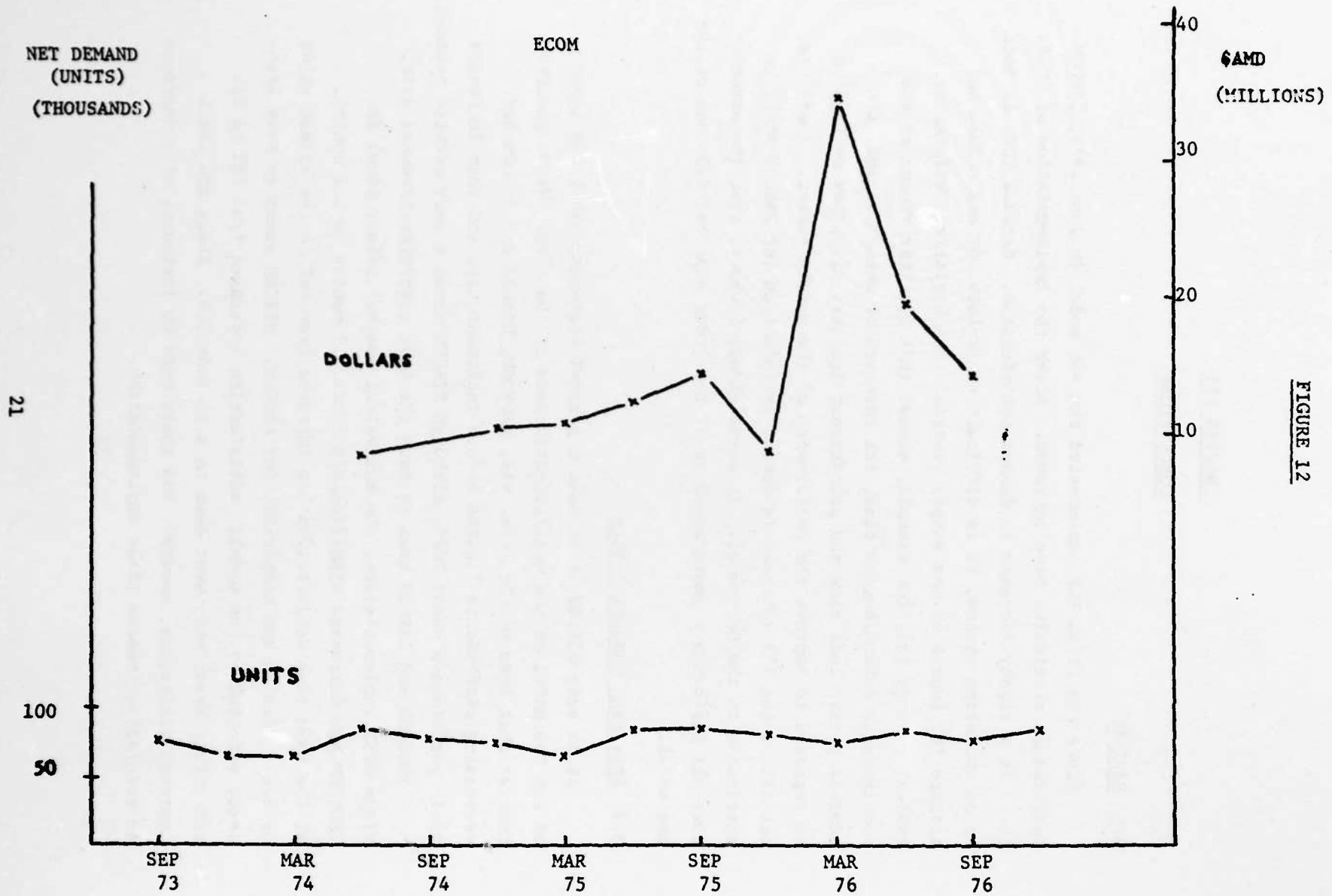

ECOM
NET DEMAND
(UNITS)
(THOUSANDS)
$AMD
(MILLIONS)
40
30
20
10
DOLLARS
UNITS
100
50
SEP 73
MAR 74
SEP 74
MAR 75
SEP 75
MAR 76
SEP 76

FIGURE 12

CHAPTER III

CONCLUSIONS

3.1 DARCOM

Since the first ICP implemented the DoD model in June 1974, DARCOM performance statistics have improved. After the implementation of CCSS, there is a steady increase in demand satisfaction. Because CCSS is such an encompassing system, it is difficult to isolate any one module and measure its impact on the supply process. The Logistics Performance Indicator study [5], for example, showed that the improvement of the requirements determination time, the forecast of annual demand, the administrative lead time and procurement delivery slippages could also be expected to improve the performance of the supply system. Therefore, not all of the 15% increase in demand satisfaction for DARCOM might be attributed to the DoD model. It seems clear, however, that the observed over-all performance improvement is of the order expected from use of the new model.

3.2 Inventory Control Points

It is very difficult to make a general statement about the impact of the DoD model on the cost/effectiveness of the ICPs. We do observe however that some of the ICPs, viz, TROSCOM, MIRCOM and ARRCOM had decreasing performance figures before implementation and then increased their performance under CCSS, although MIRCOM shows a very erratic pattern.

TROSCOM and ARRCOM seem to have the best cost/effectiveness rate. Since CCSS implementation, the equivalent months' safety level for TROSCOM has decreased significantly (from 3.7 months to 1.1 month). At the same time satisfaction has improved from 64% to the latest value of 82%. Results are comparable for ARRCOM. MIRCOM seems to have been least affected by the model; satisfaction increased from 73% to 83% but safety level only went down to 5.25 from 5.6. These are still improved statistics, however, and there were no instances of a decrease in cost/effectiveness after implementation.

APPENDIX

There were two sources of data for this analysis, MILSTEP [3] and the STRAT [1]. MILSTEP provided the performance measures and STRAT the dollar measures. Since some adjustments were made in order to put the data in the form presented above, some of the basic values are shown here. The backorders represent backorders against stock replenishment and are not applicable to non-stocked items. The backorder value represents requisitions which cannot be satisfied from stock-on-hand and a partial requisition backordered counts as one backordered requisition. This figure does not include direct deliveries [3].

The net demand is a value derived from the total number of requisitions minus the requisitions which result in a passing action to other services or requisition rejects to the customer [3].

The Budget Stratification report has many breakouts. The ones we used are all in the form of dollar value except for the month equivalent entries. The dollar values presented here represent both stock fund and APA dollars. The dollar value of forecasted safety level requirements can be picked up directly from the STRAT output [1].

The dollar value of average monthly demand must be computed. The forecasted procurement cycle time requirement and the equivalent months procurement cycle time were used in this computation. The dollar value of average monthly demand is the requirements divided by the months [1].

The numbers presented here are sufficient to compute the points necessary to plot the graphs presented in this report.

(IN THOUSANDS)		SEP 73	DEC 73	MAR 74	JUN 74	SEP 74	DEC 74	MAR 75
DARCOM*	BO	174.9	151.5	126.8	126.2	129.3	115.5	118.7
	Net Demand	551.1	528.0	463.4	486.7	506.9	492.8	501.3
	$SL (REQ)				171.6			184.5
	$AMD				56.7			67.1
TROSCOM	BO	5.4	5.4	4.8	5.5	2.5	4.6	5.3
	Net Demand	17.6	17.2	14.6	15.3	8.2	17.4	17.2
	$SL (REQ)				7.6		3.1	2.8
	$AMD				2.0		4.9	4.8
ARRCOM	BO	25.1	24.6	23.6	22.9	30.4	26.3	26.7
	Net Demand	100.5	95.0	88.0	85.6	101.5	92.3	95.6
	$SL (REQ)				29.9		33.6	36.5
	$AMD				10.8		9.9	9.8
ECOM	BO	29.8	25.8	28.7	32.0	29.7	26.2	22.7
	Net Demand	80.0	66.7	67.6	86.9	79.1	74.9	66.4
	$SL (REQ)				14.8		1.7	24.4
	$AMD				8.4		10.6	10.8
AVSCOM	BO	52.1	45.0	37.8	38.5	34.3	34.2	39.8
	Net Demand	132.8	124.5	106.0	117.2	115.1	118.5	109.4
	$SL (REQ)				67.8			63.4
	$AMD				18.2			20.4
TARCOM	BO	86.0	69.9	53.7	51.0	54.6	44.4	39.5
	Net Demand	268.9	253.3	224.2	237.4	249.2	230.1	250.0
	$SL (REQ)				41.9		41.8	50.7
	$AMD				21.3		24.9	26.5
MIRCOM	BO	6.4	6.5	7.0	8.3	7.4	5.9	7.3
	Net Demand	35.3	38.1	30.6	31.1	32.8	34.5	29.1
	$SL (REQ)				24.3		32.7	31.0
	$AMD				4.3		5.5	5.6

*Without ECOM

	(IN THOUSANDS)	JUN 75	SEP 75	DEC 75	MAR 76	JUN 76	SEP 76	DEC 76
DARCOM*	BO	117.6	110.0	101.7	88.6	92.9	94.8	96.9
	Net Demand	585.3	587.6	561.7	568.2	598.2	639.9	635.4
	$SL (REQ)	190.4		162.1	158.5		177.8	
	$AMD	72.0		76.9	70.4		74.8	
TROSCOM	BO	3.6	3.8	3.4	3.2	3.7	6.0	4.8
	Net Demand	20.9	22.2	21.7	22.2	25.2	34.5	26.7
	$SL (REQ)	6.0	8.7	8.4	5.3	6.1	7.0	
	$AMD	5.8	5.6	7.2	6.8	6.0	6.0	
ARRCOM	BO	29.0	26.0	24.5	22.0	24.5	22.3	24.7
	Net Demand	112.2	108.0	106.4	110.0	122.7	122.2	127.0
	$SL (REQ)	19.1	18.0	18.6	18.1	24.9	20.5	
	$AMD	11.9	11.7	13.0	15.6	12.9	10.9	
ECOM	BO	29.5	28.3	22.5	16.0	21.3	20.5	20.8
	Net Demand	83.3	84.6	81.0	72.0	81.9	74.9	77.6
	$SL (REQ)	30.5	17.6	41.4	21.7	13.9	12.6	
	$AMD	12.0	14.5	8.7	35.0	19.7	14.0	
AVSCOM	BO	32.8	28.5	25.2	18.6	18.0	18.5	17.6
	Net Demand	117.7	121.1	107.0	102.4	113.3	109.8	106.2
	$SL (REQ)	78.3		59.2	47.3	64.5	77.2	
	$AMD	19.7		20.8	11.7	19.8	23.8	
TACOM	BO	43.6	43.4	41.2	37.4	39.5	41.4	41.0
	Net Demand	297.0	296.2	288.4	266.0	299.6	334.2	323.0
	$SL (REQ)	57.5		46.9	57.1		45.1	
	$AMD	27.7		29.9	30.6		28.8	
MICOM	BO	8.7	8.2	7.5	7.3	7.2	6.7	8.8
	Net Demand	37.5	40.1	38.2	67.6	37.5	39.1	52.4
	$SL (REQ)	29.5	30.1	29.1	30.8	26.7	28.1	
	$AMD	6.8	6.5	5.9	5.7	5.4	5.3	

*Without ECOM

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